Message Text

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PM-03 INR-07 L-02 ACDA-10 NSAE-00 PA-02 RSC-01 PRS-01

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UNCLAS SECTION 1 OF 2 USNATO 0515

E.O. 11652: NA
TAGS: TGEN, ENRG, NATO
SUBJECT: NATO SCIENCE - SCIENCE COMMITTEE MEETING AT NATO
FEBRUARY 6-7, 1975 - PROPOSAL FOR SCIENCE COMMITTEE CONFERENCE
ON THERMAL ENERGY STORAGE

REF: USNATO 245

SUMMARY: GROUP OF EXPERTS FROM CANADA, DENMARK, FRG, NETHERLANDS, US AND UK MET AT NATO ON 27 JANUARY AND PREPARED PROPOSAL FOR SCIENCE COMMITTEE (SC) CONFERENCE ON THERMAL ENERGY STORAGE (TSE). US PARTICIPANT WAS PROFESSOR FRED MORSE OF UNIVERSITY OF MARYLAND. GROUP CONCLUDED THAT INTERDISCIPLINARY MEETING ON TOPIC WOULD BE UNIQUE AND PARTICULARLY VALUABLE CONTRIBUTION AT THIS TIME; SEVERAL COUNTRIES ARE AT VERY PRELIMINARY STAGE IN PLANNING R&D PROGRAMS IN TSE, AND FINDINGS OF SUCH A CONFERENCE COULD BE HIGHLY USEFUL ADJUNCT TO NATIONAL PLANNING. IF CONFERENCE APPROVED BY SCIENCE COMMITTEE (SC), THIS WOULD CALL FOR ALLOCATION BY SC OF 1,900,000 BF FROM FUNDS AVAILABLE UNDER PROGRAM PLANNING ITEM OF SC BUDGET. CONFERENCE WOULD TAKE PLACE IN FALL OF 1975 OR
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SPRING OF 1976. HIGHLIGHTS OF PROPOSAL FOLLOW. COMPLETE TEXT (ASG.SEA (75) 021, DATED 30 JANUARY), POUCHED TO DEPARTMENT OES HEMILLY. END SUMMARY.
BEGIN TEXT.

I. INTRODUCTION.

THERMAL ENERGY STORAGE (TES) IS DEFINED HERE AS ENERGY STORAGE BY THE HEATING, MELTING OR VAPORIZING OF A MATERIAL, OR BY A CHEMICAL DECOMPOSITION OR COMBINATION; THE ENERGY BECOMES AVAILABLE AS HEAT WHEN THE PROCESS IS REVERSED. TES HAS SEVERAL CHARACTERISTICS WHICH MAKE IT AN ATTRACTIVE TOPIC FOR THE TYPE OF INTERDISCIPLINARY, RESEARCH-STIMULATION EFFORTS WHICH ARE CHARACTERISTIC OF THE SCIENCE COMMITTEE CONFERENCES.

IT HAS WIDESPREAD POTENTIAL. ALMOST EVERY ENERGETIC PROCESS PRODUCES SURPLUS HEAT. DIRECT STORAGE OF THIS HEAT FOR FUTURE OR ALTERNATIVE APPLICATION CAN BE AN IMPORTANT FACTOR IN THE OVERALL EFFICIENCY OF MAN'S ENERGY USE. IN MANY INDUSTRIAL PROCESSES HEAT (OR COLD) IS USED PERIODICALLY OR IS AVAILABLE FOR RECOVERY PERIODICALLY (E.G. IN METAL CASTING, HEAT TREATMENT, BATCH DRYING AND COOLING OF FOOD). IN CERTAIN ENERGY SYSTEMS - E.G. SOLAR ENERGY - THE PRIMARY SOURCE IS INTERMITTENT AND STORAGE IS THE SIMPLEST WAY TO ACHIEVE CONTINUITY OF SUPPLY. IN CENTRAL POWER SYSTEMS, LEVELLING OF LOAD PEAKS AND TROUGHS MIGHT BE AMENABLE TO HEAT STORAGE TECHNIQUES. ADDITIONALLY, SUCH TES MIGHT INCREASE THE OVERALL EFFICIENCY OF SUCH SYSTEMS.

IT IS INTERDISCIPLINARY. EXPLORATION OF LARGE AND SMALL SCALE, SHORT AND LONG TERM STORAGE SYSTEMS REQUIRES CLOSE COOPERATION BETWEEN CHEMISTS, PHYSICISTS AND ENGINEERS. MOREOVER, TES HAS NOT BEEN TREATED TO DATE IN A PURPOSEFUL AND COMPREHENSIVE ANALYTICAL WAY, AND USER NEEDS AND SYSTEMS CAPABILITIES HAVE NOT BEEN SUFFICIENTLY COMPARED.

THERE IS REASON TO EXPECT SUCCESSFUL NEW APPROACHES. THERE IS NOW A SENSE OF URGENCY WITH RESPECT TO IMPROVEMENTS IN OUR HANDLING OF ENERGY WHICH NEVER EXISTED BEFORE. AVENUES MERITING FURTHER EXPLOITATION INCLUDE BOTH LATENT HEAT AND SENSIBLE HEAT SYSTEMS, AT HIGH AND LOW TEMPERATURES. FOR EXAMPLE:

(A) IRON ORE (MAGNETITE) AND CERTAIN OTHER MATERIALS
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EXHIBIT A VOLUMETRIC HEAT CAPACITY EQUIVALENT TO THAT OF WATER BUT EXTENDING TO A MUCH HIGHER TEMPERATURE - UP TO 500 DEGREES TO 600 DEGREES C.
(B) FERRIC CHLORIDE MELTS AT 305 DEGREES C WITH A HEAT OF FUSION OF 181 CAL/CM TO THE THIRD POWER (UEPNPPP BTU/M TO THE THIRD POWER). THIS COULD BE ECONOMICALLY SIGNIFICANT IN SMOOTHERING ELECTRIC SPACE-HEATING LOADS.

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(C) SULFER TRIOXIDE CAN BE DECOMPOSED AT ABOUT 800 DEGREES C (E.G. IN A FOCUSSING SOLAR COLLECTOR); THE PRODUCTS SO 2 AND O 2 CAN LATER BE REACTED OVER A PT CATALYST AT ABOUT 100 DEGREES C, WHEREBY THEY COMBINE TO REFORM SO 3 IN A STRONGLY EXOTHERMIC REACTION, PROVIDING LARGE AMOUNTS OF HEAT ENERGY IN THE 400 DEGREES-600 DEGREES C RANGE.
(D) THE USE OF VERY LARGE PABBLE BEDS OR ROCK PILES, OR UNDERGROUND CAVES FOR STORAGE OF HOT (OR COLD) AIR (OR WATER) APPEARS FEASIBLE FOR QUITE LONG TERM STORAGE.
(E) COMBINATIONS OF SENSIBLE- AND LATENT-HEAT STORAGE SYSTEMS ARE UNDER INVESTIGATION. THUS, IRON CYLANDERS CONTAINING SEALED INSERTS OF, FOR EXAMPLE, SODIUM HYDROXIDE, ARE MUCH MORE EFFICIENT THAN IRON ALONE. SIMILARLY, THE PHASE-CHANGE OF PARAFFIN HYDROCARBONS IS BEING EXPLOITED IN CONJUNCTION WITH THE HIGH SPECIFIC HEAT OF WATER BY ENCAPSULATING THE PARAFFIN IN CROSS-LINKED GELATINE TO FORM WATER-BORNE SLURRIES WITH SEVERAL TIMES THE EFFECIENCY OF PURE WATER.

ENCOURAGEMENT AND RESEARCH EVALUATION IS NEEDED. PAST WORK ON TES HAS BEEN CARRIED OUT LARGELY ON AN INDIVIDUAL BASIS.
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NO PROFESSIONAL SOCIETY OR NATIONAL RESEARCH CENTRE IS PRESENTLY CONCERNED WITH THE ENTIRE SPECTRUM OF POSSIBLE APPROACHES, AND NO REGOROUS ASSESSMENT OF THEORETICAL AND PRACTICAL EXPECTATIONS AND LIMITATIONS IS READILY AVAILABLE. THE OPPORTUNITIES FOR SIGNIFICANT ADVANCES APPEAR TO BE SUFFICIENTLY PROMISING THAT FUIDELINES AND RESEARCH RECOMMENDATIONS WOULD BE USEFUL TO A WIDE GROUP OF POTENTIAL CONTRIBUTORS.

II. PURPOSE AND GOALS

THE PROPOSED CONFERENCE WOULD BRING TOGETHER 50-60 WORKERS ON PROBLEMS RELEVANT TO TES, INCLUDING CHEMISTS, PHYSICISTS, AND ENGINEERS. USER GROUPS SUCH AS UTILITIES AND INDUSTRIES WOULD BE INCLUDED TO INSURE THAT NEEDS AND CAPABILITIES ARE TREATED IN REALISTIC CONCERT. IT WOULD BE THE TASK OF WORKING GROUPS TO ASSESS THE PRESENT STATE OF KNOWLEDGE WITHIN THEIR OWN SPECIALTIES, TO IDENTIFY THE LIMITING CRITICAL FACTORS, TO INDICATE AREAS WHERE ADVANCES MIGHT BE MADE AND TO EXAMINE NEGLECTED INTERACTIONS, SUCH AS THOSE RELATED TO THE UTILIZATION OF TES AS PART OF LARGER SYSTEMS, WHICH CROSS THE BOUNDARIES OF DISCIPLINES AND SPECIALIZED APPLICATIONS.

WHILE EMPHASIS WOULD BE ON IDENTIFICATION AND ELABORATION OF THE FUNDAMENTAL PROPERTIES OF MATERIALS AND PROCESSES CAPABLE OF APPLICATIONS TO TES, THE IMPACT OF TES ON OVERALL ENERGY STRUCTURES WOULD ALSO BE ANALYZED.

III. CONFERENCE PROGRAMME

A FIVE-DAY MEETING IS PROPOSED. ON THE FIRST DAY A SERIES OF PLENARY PRESENTATIONS WOULD ACQUAINT ALL PARTICIPANTS WITH THE CONCEPTS AND PROBLEMS OF THE VARIOUS SPECIALTIES. THE PARTICIPANTS WOULD THEN DIVIDE INTO WORKING GROUPS TO DEFINE THE CURRENT KNOWLEDGE BEARING ON THEIR SUBJECT AND DRAW UP RECOMMENDATIONS AIMED AT FILLING GAPS IN THIS KNOWLEDGE AND OUTLINING KEY NEEDS IN DATA AND EXPERIMENTATION. THE FINAL DAY WOULD BE DEVOTED TO PLENARY CONSIDERATION OF THE INDIVIDUAL WORKING GROUP REPORTS.

PARTICIPANTS WOULD BE INVITED TO CONTRIBUTE TO A VOLUME OF WORKING PAPERS WHICH WOULD BE DISTRIBUTED IN ADVANCE TO ALL PARTICIPANTS, TO ALLOW THE MEETING TO EMPHASIZE DISCUSSION RATHER THAN PRESENTATIONS.

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PLENARY PRESENTATIONS ARE PROVISIONALLY PROPOSED ON:
- THE ROLE OF TES IN A CENTRAL UTILITY SYSTEM
- THE ROLE OF TES IN INDUSTRIAL SYSTEMS
- THE ROLE OF TES IN RESIDENTIAL, COMMERCIAL AND URBAN SYSTEMS
- THE PRINCIPLES OF TES
- THE MATERIALS OF TES.

IT IS SUGGESTED THAT VALUABLE INTERDISCIPLINARY DISCUSSIONS COULD TAKE PLACE IN WORKING GROUPS DEALING WITH SUBJECTS SUCH AS THE FOLLOWING:
- HIGH TEMPERATURE TES (120 DEGREES C)
- LOW TEMPERATURE TES (0-120 DEGREES C)
- THERMAL TRANSFER PROCESSES
- SYSTEMS APPLICATIONS
- IMPACT OF TES ON OVERALL ENERGY STRUCTURES.

END TEXT.
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